

April 25, 1895.

The LORD KELVIN, D.C.L., LL.D., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read :—

- I. “On a Gas showing the Spectrum of Helium, the reputed cause of  $D_3$ , one of the Lines in the Coronal Spectrum. Preliminary Note.” By WILLIAM RAMSAY, F.R.S., Professor of Chemistry, University College, London. Received March 26, 1895.

In the course of investigations on argon, some clue was sought for, which would lead to the selection of one out of the almost innumerable compounds with which chemists are acquainted, with which to attempt to induce argon to combine. A paper by W. F. Hillebrand, “On the Occurrence of Nitrogen in Uraninite, &c.” (*Bull. of the U.S. Geological Survey*, No. 78, p. 43), to which Mr. Miers kindly directed my attention, gave the desired clue. In spite of Hillebrand’s positive proof that the gas he obtained by boiling various samples of uraninite with weak sulphuric acid was nitrogen (p. 55)—such as formation of ammonia on sparking with hydrogen, analysis of the platinichloride, vacuum-tube spectrum, &c.—I was sceptical enough to doubt that any compound of nitrogen, when boiled with acid, would yield free nitrogen. The result has justified the scepticism.

The mineral employed was clèveite, essentially a uranate of lead, containing rare earths. On boiling with weak sulphuric acid, a considerable quantity of gas was evolved. It was sparked with oxygen over soda, so as to free it from nitrogen and all known gaseous bodies except argon; there was but little contraction; the nitrogen removed may well have been introduced from air during this preliminary experiment. The gas was transferred over mercury, and the oxygen absorbed by potassium pyrogallate; the gas was removed, washed with a trace of boiled water, and dried by admitting a little sulphuric acid into the tube containing it, which stood over mercury. The total amount was some 20 c.c.

Several vacuum-tubes were filled with this gas, and the spectrum was examined, the spectrum of argon being thrown simultaneously into the spectroscope. It was at once evident that a new gas was present along with argon.

Fortunately, the argon-tube was one which had been made to try

whether magnesium-poles would free the argon from all traces of nitrogen. This it did; but hydrogen was evolved from the magnesium, so that its spectrum was distinctly visible. Moreover, magnesium usually contains sodium, and the D line was also visible, though faintly, in the argon-tube. The gas from clèveite also showed hydrogen lines dimly, probably through not having been filled with completely dried gas.

On comparing the two spectra, I noticed at once that while the hydrogen and argon lines in both tubes accurately coincided, a brilliant line in the yellow, in the clèveite gas, was nearly *but not quite* coincident with the sodium line D of the argon-tube.

Mr. Crookes was so kind as to measure the wave-length of this remarkably brilliant yellow line. It is 587·49 millionths of a millimetre, and is exactly coincident with the line  $D_3$  in the solar chromosphere, attributed to the solar element which has been named *helium*.

Mr. Crookes has kindly consented to make accurate measurements of the position of the lines in this spectrum, which he will publish, and I have placed at his disposal tubes containing the gas. I shall therefore here give only a general account of the appearance of the spectrum.

While the light emitted from a Pflücker's tube charged with argon is bright crimson, when a strong current is passed through it, the light from the helium-tube is brilliant golden yellow. With a feeble current the argon-tube shows a blue-violet light, the helium-tube a steely blue, and the yellow line is barely visible in the spectroscope. It appears to require a high temperature therefore to cause it to appear with full brilliancy, and it may be supposed to be part of the high-temperature spectrum of helium.

The following table gives a qualitative comparison of the spectra in the argon\* and in the helium-tubes.

	<i>Argon-tube.</i>		<i>Helium-tube.</i>
Red .....	{ 1st triplet. 2nd pair. Faint line. Stronger line. Brilliant line. Strong line.	{ 1st triplet. 2nd pair. Faint line. Stronger line. Dull line. Very dim line.	Equal in intensity. " " " " " " " " } Weak in helium.
Red-orange ...	{ Moderate Line. " " " "	{ Moderate line. " " " "	Equal in intensity. " " " "
Orange .....	{ Faint line. Triplet.	{ Faint line. Triplet.	" " " "
Orange-yellow .	Pair.	Pair.	" "

\* The tube then used was the one with which Mr. Crookes's measurements of the argon spectrum were made. It contains absolutely pure atmospheric argon.

<i>Argon-tube.</i>		<i>Helium-tube.</i>	
Yellow .....	Absent.	Brilliant.	$W = 587\cdot49$ . (the helium line, $D_3$ )
Green .....	7 lines.	7 lines.	Equal in intensity.
Green-blue ....	{ 5 lines. Absent. Absent.	5 lines. Faint. Brilliant.	" " In helium only.
Blue .....	Absent.	8 lines.	" "
Blue-violet ....	{ 3 lines, strong. 2, fairly strong. Absent. Absent. Violet pair.	Barely visible, if indeed present at all. 2, fairly strong. Bright line. 4 bright lines.	Equal in intensity. } In helium only.
Violet .....	{ Single line. Triplet. Triplet. Pair.	Violet pair. Single line. Triplet. Triplet. Pair.	Equal in intensity. " " " " " " " "

It is to be noticed that argon is present in the helium-tube, and by the use of two coils the spectra could be made of equal intensity. But there are sixteen easily visible lines present in the helium-tube only, of which one is the magnificent yellow, and there are two red lines strong in argon and three violet lines strong in argon, but barely visible and doubtful in the helium-tube. This would imply that atmospheric argon contains a gas absent from the argon in the helium-tube. It may be that this gas is the cause of the high density of argon, which would place its atomic weight higher than that of potassium.

It is idle to speculate on the properties of helium at such an early stage in the investigation; but I am now preparing fairly large quantities of the mixture, and hope to be able before long to give data respecting the density of the mixture, and to attempt the separation of argon from helium.

(Note added June 14.—It is now practically certain that the presence of so many of the argon lines in the helium spectrum must have been due to the accidental introduction of air. But there still are coincidences, chiefly in the red lines, which would justify the supposition that there is some constituent common to the two gases.)

## II. "On the new Gas obtained from Uraninite. Preliminary Note." By J. NORMAN LOCKYER, C.B., F.R.S. Received April 25, 1895.

On the 28th of March, Professor Ramsay was so good as to send me a tube containing a new gas obtained by him from uraninite (cléeveite), showing a line in the yellow which was stated to be of the